Final Report for:

Calculation Methods for Rotor Wake Formation

in Forward Flight

(NASA Grant NAG2-421)

to

Helicopter Aeromechanics Branch
NASA Ames Research Center

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1 Summary

The primary focus of this research centered on improving the vorticity-capturing properties of Eulerian flow solvers in convection-dominated flows. The work was motivated by the fact that excessive numerical diffusion observed in current Euler solvers on grids of feasible size is a major obstacle to accurately computing the flow about helicopter rotors, especially in the forward flight case.

The work was originally supported by NASA Grant NAG2-421 for two years. After loss of this funding, the work continued for four more years under an ONR contract. The reasearch goal — reduction of numerical diffusion in Euler solvers — remained the same, although the target application was now the prediction of internal vortical secondary flows. This was part of a larger ONR-sponsored research program at MIT aimed at reducing the noise of turbopumps.

The research work culminated in the PhD thesis of Ms. Helene Felici, titled "A Coupled Eulerian/Lagrangian Method for the Solution of Three-Dimensional Vortical Flows." This was accepted by the MIT Department of Aeronautics and Astronautics in June 1992. Two articles based on part of this material were presented at the 1993 AIAA Fluid Dynamics Conference (paper 93-2928), and the 1993 AIAA CFD Conference (paper 93-3370-CP). The former has been sumitted to the Journal of Computational Physics, and is currently in review. The thesis and the papers are attached as Appendices A, B, and C. These form the technical reporting here.